MEMORANDUM

DEPARTMENT OF TRANSPORTATION
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Date: May 31, 2000

To: All Bridge Worksheet Users

From: S. W. Horton, Bridge Branch Manager

Subject: CDOT Bridge Worksheet Revisions

The CDOT Bridge Worksheets have recently been updated. This update involves 51 English unit worksheets. Many of the changes concern the new policy of 3" maximum overlay thickness on bridges. A technical memorandum announcing this new policy will be issued in June.

Only a few changes have been made to the metric worksheets, as noted below. We have stopped full maintenance of the metric worksheets. The metric worksheets will be available in their current versions until December 31, 2000. At that time they will be deleted.

The following is a summary of the revisions.

B-INDEX-1 & 2: Updated indexes.

B-000-0: This worksheet has been deleted and its contents transferred to B-100-1.

B-000-1: Name change from outline to border.

B-000-2: This is the automated sheet border, and has been given a new filename (B-000-2) matching the worksheet number.

B-100-1: Updated to include the General Notes and Design Data from B-000-0. Updated the live load, specifications, and fatigue portions of the design data for the LRFD code. Updated the dead load portion of the design data for 3" maximum overlay, and added a note to the designer/detailer regarding this.

B-202-1C: Updated for 3" HBP.

B-202-1S: Updated for 3" HBP and corrected spelling of concrete replacement figure title.

B-206-F1 & F2: Changed sheet numbers from B-206-1 & 2. Maximum slope changed from 1:1 to 2:1. Moved bottom of polystyrene/cardboard up to top of the perforated pipe underdrain. Added flowfill to the summary of quantities. Made it explicit that all work is to be included in the flowfill pay

item for payment. Revised the flowfill "layer" description to "lift". Miscellaneous wording and detail improvements.

B-206-M1 & M2: New worksheets. These sheets provide for MSE abutment backfill instead of flowfill. It is expected that MSE backfill will be used for most bridges instead of flowfill. The main advantage is cost, however in some situations the MSE may also provide several options for optimizing the abutment and wingwall design; e.g., replacing long cantilever wingwalls with MSE walls, replacing the bottom portion of tall abutments with MSE wall, or reliably and economically removing earth pressures from the abutment/wingwalls when warranted by long bridge or wingwall length, tall abutments, or severe skews.

Flowfill was implemented in 1992 primarily to reduce shallow settlement at abutment approaches. MSE will also reduce shallow settlement effects, and with the fabric wraps, provide superior retention of fines, for less cost than flowfill. The MSE will not however be as quick nor as easy to construct. Consequently flowfill will remain an option for projects where these advantages warrant the additional costs; e.g., a project where the excavation presents a deep awkward hole to fill in a minimum amount of time. Note, these sheets (with B-206-3 & 4) include all the information necessary for this work. A special provisions is not required.

B-206-3 & 4: Updated to include MSE as well as flowfill. Miscellaneous improvements to notes and organization of details. The minimum limits for structure excavation and fill on the interior side of abutments and wingwalls has been changed from a 1:1 slope to 2:1.

Placing embankment on a 1:1 slope is difficult and can lack the compaction necessary for the bridge approaches. Although the 1:1 standard is satisfactory as a cut, in either existing ground or new roadway embankment, it is often embankment as the contractor fills in the work zone behind the abutment, minimizing the more expensive flowfill and MSE embankment. Previously B-206-4 had an over-embankment provision to address this (where embankment was placed on a 2:1 and then cut back to 1:1). This provision was difficult to interpret and pay for. This provision is eliminated by using 2:1 slopes for the interior structure earthwork limits. The 2:1 slopes also provides a better transition in stiffness from the MSE or flowfill to the adjacent embankment, further reducing bumps. It will cost more on structures without approach slabs, short approach slabs, and deep abutments. Nearly all bridges however will have 20' approach slabs, which in itself would usually require flatter slopes.

When placing the abutment in a cut of very good material, e.g. rock, the designer should note this in the plans and allow the Contractor to reduce the minimum limits of structural earthwork as approved by the Engineer. We do not want to pay extra to remove material that is better than either MSE or flowfill.

When placing an abutment or pier in a cut of very poor material, the 1:1 slopes for the pier and outside of the abutment and wingwalls may be inadequate per OSHA, and flatter slopes might be required. The worksheets should be modified accordingly for this situation.

B-504-A1 & A3: Miscellaneous minor improvements to call-outs for the rail anchoring slab, and the perforated pipe collector.

B-507-1 & 2: Deleted "mesh" from the description of the polypropylene fibers. Added definition of the berm slope to B-507-1.

B-518-1: Updated for 3" HBP. Corrected and clarified the vent hole location call-out.

B-518-M1C & M1S: Updated the Typical Section for the new bridge rail dimensions, see B-606-7A & 7B below. Minor correction to the 0.25" lip call-out in the Sections on B-618-M1S.

B-601-1: Updated for 2" of cover. Added call-out for waterproofing membrane on the approach slab.

B-601-1EA & 1EC: Updated for 3" HBP. On B-601-1EC, eliminated the step in the bottom of the approach slab and revised the top cover to 3". Updated B-601-1EA for 2" of cover.

B-601-3: Added geocomposite drains as an alternative at the backface of retaining walls. Defined the filter material as Class B. Added a footing to the expansion joints detail to show that the joints should not pass through the footing. Changed the wall face offsets to a uniform 1%. Miscellaneous minor detailing improvements.

B-606-3 & 3W: Updated for 3" HBP, see table below. Added reference to the Type 3L End Anchorage. Corrected tube splice bolt length. Corrected and clarified the tube/post connection bolt hole locations. At end with terminal section, extended pay limits to end of curb. At end with transition section, extended tubes to the end of the curb. Miscellaneous minor improvements to details. Expanded note on joints in the curb to include joints that do not necessarily have an expansion device; e.g., the joint between the backface of abutment and approach slab which must continue through the curb when the rail is mounted on the approach slab.

B-606-7A & 7B: Updated for 3" HBP, see table below. Eliminated separate bar at backface of rail by extending bar projecting from deck. Rebar quantities updated from 17.1 to 16.2 pounds per linear foot. Changed drawing number from B-606-7 to B-606-7B. Reference for location of bottom dowel, for the bridge rail to guardrail transition, changed from finished grade to top of rail.

B-606-7T: New worksheet to show guardrail to bridge rail transition details.

B-606-8A & 8B: Updated for 3" HBP, see table below. Corrected bridge rail height on B-606-8A. Corrected thrie-beam height on B-606-8B.

B-606-10, 10A, 10B, 10H, 10P, 10R, & 10T: Updated for 3" HBP, see table below. Added cross referencing to other worksheets with drawing number on sheet. On 10 & 10R expanded note on joints in the curb to include joints that do not necessarily have an expansion device; e.g., the joint between

the backface of abutment and approach slab which must continue through the curb when the rail is mounted on the approach slab. Miscellaneous minor improvements to detailing on 10, 10A, & 10B.

PREVIOUS POLICY							
PREVIOUS BRIDGE RAIL HEIGHTS (FOR 2" FUTURE OVERLAY)							
Bridge Rail	Overlay @ New Constrctn	Bridge Rail Height above deck	Bridge Rail Height above TOG	Guardrail Height above TOG per M-Stds	Guardrail to Bridge Rail Transition	Future Overlay	Bridge Rail Hgt. Above TOG after future overlay
3	2"	31"	29"	27"	up 2"	2"	27"
3	0	29"	29"	27"	up 2"	2"	27"
7	2"	36"	34"	34"	0	2"	32"
7	0	34"	34"	34"	0	2"	32"
8	2"	36"	34"	34" or 31"	0 or up 3"	2"	32"
8	0	34"	34"	34" or 31"	0 or up 3"	2"	32"
10	2"	35"	33"	31"	up 2"	2"	31"
10	0	33"	33"	31"	up 2"	2"	31"

CURRENT POLICY							
CURRENT BRIDGE RAIL HEIGHTS (FOR 3" MAXIMUM OVERLAY)							
Bridge Rail	Overlay @ new constrctn	Bridge Rail Height above deck	Bridge Rail Height above TOG	Guardrail Height above TOG per M-Stds	Guardrail to Bridge Rail Transition	Future Overlay	Bridge Rail Hgt. Above TOG after future overlay
3	3"	30"	27"	27"	0	0	27"
3	0	30"	30"	27"	up 3"	3"	27"
7	3"	35"	32"	34"	down 2"	0	32"
7	0	35"	35"	34"	up 1"	3"	32"
8	3"	35"	32"	34" or 31"	down 2" or up 1"	0	32"
8	0	35"	35"	34" or 31"	up 1" or up 4"	3"	32"
10	3"	35"	32"	31"	up 1"	0	32"
10	0	35"	35"	31"	up 4"	3"	32"

B-607-5: Corrected bar, hole, & bolt size in anchorage detail.

B-607-6B: Corrected horizontal location of post with respect to Type 7 bridge rail. Added bicycle rub rail.

B-607-6S: Worksheet deleted. This was an older worksheet with a 6’ high chain link fence on top of the Type 7 bridge rail. The fence had horizontal bars located adjacent to traffic. When a fence is adjacent to traffic, horizontal members within the fence should not be used. B-607-3 and B-607-5 should be used for this situation.

B-607-8B: Updated height of pedestrian handrail from 32” to 34” per ADA requirements (see CDOT Bridge Design Manual Subsection 2.2).

B-618-2 & 5: Added note to concrete placing schedule reminding designers to determine the appropriate location of construction joints at the abutment and show them accordingly. Revised section A on B-618-2 to show that CDOT does not require fillets between the deck and girder webs. The maximum jacking force per duct is larger now than used in the past (see CDOT Bridge Design Manual Subsection 9.1), resulting in larger bursting forces at changes in the duct path. Consequently, added a table for duct curvature to limit localized web splitting from curved ducts. The table design is based on concrete tensile strength as the primary resisting strength (a concrete ultimate tensile strength of 275 psi after a 0.7 strength reduction factor was used), with the cross reinforcing functioning at rebar yield strength as a backup to prevent "unzipping" and arrest any cracks that do form. This was calculated at the ultimate tendon strength with a load factor of 1.0. Additionally, the flare for exterior girders was flattened from 1:12 to 1:24.

B-618-3 & 6: Revised to allow only basic bearing plate anchorage systems. Cast anchorage's will no longer be allowed. Provided bearing plate and spiral design table. Added requirements for more complete information in the shop drawings. Changed minimum cover on anchorage's from 2" to 4". A project special provision is now required to modify shop drawings requirements and delete allowance for alternate anchorage systems. This 618 project special can be found on CDOT's Staff Bridge web page.

B-618-BX: Revised note to Contractor and added note to designer/detailer regarding harping and sleeving strands. Precast fabricators generally prefer to use debonded strands over harping, and it should result in somewhat lower costs. Designers should consider debonding during design. Note that both PSG and CONSPAN provide for debonded designs.

Debonding more than half of the strands in any row, or more than 38% of the total number of strands, is not recommended. This value should possibly be reduced to 25% on multi-span bridges unless the effect of shear is thoroughly evaluated. The pier end of end spans has a somewhat larger shear than a simple span would, and the negative moment can interact adversely with the shear in the top of the web, especially if the top of web near the end of the girder is also subject to tension from prestressing, as is typically the case with debonded designs.

Debonding more than 4 strands at any one location in the span is also not recommended. Developing strands induces a localized secondary vertical tensile force. There is extra vertical reinforcing in the ends of prestressed girders for this force, but possibly insufficient reinforcement at other locations for the development of more than 4 strands at a time.

B-618-DF: Reorganized location of details on the sheets.

B-GEO-1: Updated border and changed drawing name.

B-SPECL-13: Added drawing showing the special font characters used for the worksheets. The ACAD special font file (Specl13.shx) can be found on CDOT's Staff Bridge web page.

C-INDEX-1 & 2: Updated metric indexes.

C-504-A2: Corrected equation for rail impact.

C-606-3A: Corrected bolt length for tube splices.

C-GEO-1: Changed drawing name and added to index of worksheets.

These updates and all of the worksheets are available through the CDOT bridge web page.

http://www.dot.state.co.us/business/Design/Bridge/index.htm

Please review and become familiar with these revisions. If you have any questions or recommendations for improvements to the worksheets please contact:

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